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“A Bale Handling Apparatus”

INTRODUCTION

5    Field of the Invention

The invention relates to bale handling apparatus especially for large “round” bales for silage or haylage.

10   Prior Art Discussion

Such apparatus are described for example in US4044907 (Craft) and GB1123463 (Worsdale).

15   A major problem with the handling of wrapped bales is that the plastics wrapping can be easily damaged, for example when moving from field to storage. Baled silage is often resold during the winter months as demand for animal feed is at its highest. When the covering is damaged the quality of the silage or haylage can be seriously compromised. This is a major problem for moving bales that have been in storage for a period of time as the bales often lose their original shape and density due to the fermenting process. In such cases re-handling settled bales using  
20   conventional handlers often results in damage to the plastics wrap.

Bales, particularly round bales, are stacked in different formats, on the round or on the flat face. Different stacking methods require different bale handlers, and similarly, different variations of handlers are used on square bales. This results in farmers or contractors needing more than one  
25   type of bale handler.

Known bale handling apparatus are used to manipulate large round and/or large square bales from field to transport vehicle and from the transport vehicle to the storage area. They can take different shapes and forms, however they have restrictions in terms of the number of angles and  
30   the manner in which a bale (round bale in particular) can be approached and manipulated. Such restrictions can pose problems with operating the apparatus in a confined area where it can be difficult to approach a bale at the correct angle.

Current bale handling apparatus often in use cause damage to the plastics wrapping and break the seal in order for the settled bales that have lost their original shape to be handled for resale. The reason for this is that the mechanical gripping mechanisms do not satisfactorily accommodate the now odd-shaped bales.

5

Another problem is that a user will have to decide whether he/she needs a round bale handler or a square bale handler, as there is no bale handler that is equally efficient for both round and square bales, and picking them up at any angle.

10 Accordingly there exists a need for a bale handling apparatus that is more versatile in terms of bale type, shape and angle of approach, and/or which is less likely to damage to the wrapping in use.

#### SUMMARY OF THE INVENTION

15

According to the invention, there is provided a bale handling apparatus comprising:

a frame having a means to mount to a vehicle,

an arm pivotally mounted to the frame and having a configuration, in a direction from the frame, extending distally and then downwardly, and

20 an actuator for rotating the arm between an upper open position and a lower closed position for gripping a bale together with the frame,

wherein the frame comprises a bumper extending distally for engagement with a bale, said bumper having a front-facing curved surface.

25 In one embodiment, the frame has a lower portion and an upper portion and the arm is pivotally mounted to the frame upper portion.

In one embodiment, the arm has a proximal section mounted on the pivot joint and a distal section at its distal extremity extending downwardly with respect to a longitudinal axis of the proximal section.

30

In one embodiment, the distal section is connected to the proximal section by an intermediate section. In one embodiment, the distal section longitudinal axis extends at an angle in the range of 45° to 135°, and preferably 80° to 100° to said proximal section longitudinal axis.

Preferably, the arm actuator acts on the arm at a pivot joint proximally of the arm pivot joint.

5 In one embodiment, said actuator comprises a substantially vertically aligned hydraulic ram mounted between the frame and the arm. In one embodiment, the arm comprises at least one roller arranged to rotate freely about an axis traversing the arm. Preferably, the roller is mounted to the arm at a distal extremity of the arm. In one embodiment, there is at least one roller on each side of the arm. In one embodiment, the rollers have an axis which is substantially perpendicular to the arm.

10 In one embodiment, the arm has a box-section hollow configuration. In one embodiment, the arm comprises a pair of channels facing into each other and fastened together to form said box section.

15 In one embodiment, the frame comprises a bale-engaging seat having a bale-engaging surface and a lower leading edge. In one embodiment, the seat lower edge has a front-facing curved surface.

20 In one embodiment, the bumper is formed at least in part by round tubes.

In one embodiment, the apparatus comprises a plurality of independently-driven arms.

25 In one embodiment, the frame comprises an upper portion and a lower portion, and said upper portion is narrower than the lower portion and extends centrally upwardly with the configuration of a pillar. In one embodiment, the upper portion has a box section configuration along at least part of its length.

30 In one embodiment, the upper portion comprises a pair of lugs as extensions of side walls, said lugs supporting the arm pivot joint.

#### Additional Statements

35 The present invention relates to a bale handling apparatus, used to manipulate, transport and stack bales of any shape or size without compromising the plastic wrap. Used in conjunction with a front end loader on a tractor, this apparatus has the ability to handle both square and round bales with great efficiency. The present invention is capable of handling bales at any angle by

utilising a single pivot arm design. This design can also be adapted to facilitate handling multiple bales at a time.

5 Bale handling apparatus comprising means for attaching the apparatus to a pair of lifting arms of  
a prime mover, means for retaining a wrapped bale or multiple bales on the apparatus  
eliminating damage to the covering material, means for a manipulating bumper to facilitate any  
angle or direction approach to the bale by the prime mover, means for retaining bales of any size  
or shape on the apparatus, wherein the pivoting arm pivoting around the top pivot point at its  
10 farthest up point, facilitating a squeezing motion to be applied to the bale to retain the bale in the  
apparatus, so that the apparatus can pick up retain and place bales without risk of damage to  
covering material of bales irrespective of size or shape

A wrapped bale handling apparatus in which the hydraulically operable pivoting arm pivots from  
its top pivot point over the top of the bale to provide a squeezing action to retain a bale of any  
15 orientation or size within the apparatus, with the top pivot point positioned on the main upright  
frame at its farthest up point facilitating bales to be retained and placed at a location with the  
covering material uncompromised.

A wrapped bale handling apparatus in which a manipulating bumper comprising of a curved  
20 structure mounted on the main upright frame provides the means of the prime mover approach a  
bale from any angle or direction manoeuvring the bale into an appropriate position.

A wrapped bale handling apparatus in which multiple pivot arms can be utilized on a larger main  
upright frame with multiple main uprights to allow a means of multiple bales to be retained on  
25 the apparatus in a similar fashion as stated in the preceding claims.

A wrapped bale handling apparatus substantially as herein described with reference to, and as  
shown in, the accompanying drawings.

## 30 DETAILED DESCRIPTION OF THE INVENTION

### Brief Description of the Drawings

The invention will be more clearly understood from the following description of some embodiments thereof, given by way of example only with reference to the accompanying drawings in which:-

5            Fig. 1 is a perspective view from the front of a bale handling apparatus of the invention; and Fig. 2 is such a rear view (vehicle side);

             Figs. 3 and 4 are side views showing closed and open positions respectively of a pivot arm;

10           Fig. 5 is a rear elevational view of a frame of the apparatus, and Fig. 6 is a vertical cross-sectional view of the frame in the direction of the arrows H-H of Fig. 5, on a larger scale;

             Fig. 7 is a plan view of an arm of the apparatus without rollers, and Fig. 8 is a side cross-sectional view in the direction of the arrows G-G of Fig. 7;

15           Fig. 9 is a side view of the arm, and Fig. 10 is an end cross-sectional view in the direction of the arrows F-F of Fig. 9;

20           Fig. 11 is a side view showing the apparatus in use when mounted on a loader, gripping a round bale on diagonally opposed sides with the bale axis generally vertical; Fig. 12 is such a view when gripping a bale when the bale axis is generally horizontal, and Fig. 13 shows the apparatus gripping a bale which is in contact with another bale on the ground, in which the rollers help to separate the bales; and

25           Fig. 14 shows an alternative apparatus, in this case having two arms and a wider frame to accommodate two bales being handled at any time.

#### Description of the Embodiments

30           Referring to Figs. 1 to 4 a bale handling apparatus 1 of the invention comprises an upright frame 2 and a pivoting arm 3. The arm 3 is mounted by a pivot joint 4 to the upright frame 2 at its uppermost location.

The frame 2 comprises a lower portion 10 and a pillar 17 extending upwardly and centrally from the lower portion 10. The lower portion 10 comprises a bale seat 11 having a shallow-angled plate 12 and a more upright plate 11 forming an angle of about 150° between them. The seat 11 also has a lower edge formed by a bumper 14 of tubular steel. The frame 2 lower portion 10 also  
5 comprises a structural box section 16 around its periphery.

The pillar 17 extends centrally upwardly from the main body of the frame 2, namely the lower portion 10. As shown particularly in Fig. 2, the frame 2 is arranged to be mounted to a front loader by an arrangement of lugs suited to the configuration of the particular loader being used.  
10 This mounting allows the frame 2 to be moved with the loader, including tilting and movement generally with 360° of freedom.

The apparatus 1 is controlled by an hydraulic actuator, not shown, in a vehicle cab. This controls hydraulic operation of the arm 3.

15 As shown most clearly in Figs. 3 and 4, the arm 3 is driven about the pivot joint 4 by an hydraulic ram actuator 21 mounted between lugs 22 on the pillar 17 of the frame 2 and lugs 23 at an inner or proximal end of the arm 3, proximally of the arm pivot joint 4. In this specification the term "proximal" is used to mean the part closer to the vehicle in use and the term "distal" the  
20 part further from the vehicle.

Also, the arm 3 comprises:

a proximal section 31;

an intermediate, section 32; and

25 a distal section 33, supporting at its end a pair of lateral co-axial rollers 34.

The frame 2 is shown in more detail in Figs. 5 and 6. On the proximal side it has lugs 25 supporting the pivot joint 22, and the pillar 17 has at its top end lugs 26 for the pivot joint 4. The pillar 17 comprises a pair of channels welded together to provide an overall box-section  
30 configuration for high strength with light weight. The fact that the pillar 17 is narrow and is centrally located allows excellent visibility for the operator. Also, it provides excellent strength along the vertical direction, along which forces are transmitted by the arm 3 in use.

Referring to Figs. 7 to 10 especially, the arm 3 is shown in more detail. Advantageously, it is bent overall through an angle of about 90°, and this is preferably in the range of 70° to 100° in general. This angle is provided by the angle between the longitudinal axes of the distal section 33 and the proximal section 31. The proximal section 31 has a length suited to the maximum dimension of the bales to be lifted. The arm in any embodiment has an overall bent or cranked configuration, so that when closed it grips or clamps a bale on a side opposed to the frame 2. It has a proximal section extending distally from the frame, and a distal section extending downwardly with respect to the longitudinal axis of the proximal section.

10 Figs. 7 and 8 show axles 34(a) for the rollers 34. Figs. 7 to 10 show most clearly that the arm proximal section 31 comprises a pair of channels 36 and 37 facing into and welded to each other along joins 38 to form a box section. Like the pillar 17, this provides excellent strength with low weight.

15 Referring to Figs 11 to 13, the apparatus 1 is mounted onto the end of a tractor front loader 50 having a ram 53 coupled to the frame 2 at a pivot joint 54, the loader's main arm being connected to frame lugs 51 at a pivot joint 52. This arrangement allows the loader to tilt the frame 2, and hence the whole apparatus 1.

20 There are many different types of vehicle and loader and each bale handling apparatus will be fitted with the arrangement of mounting means such as particular configurations and locations of lugs for mounting to the loader to be used. They may be fitted on a product-by-product basis at the request of the customer, or indeed by the customer. The upright frame has structural members at several locations, providing ample possible locations for the mounting lugs or other  
25 fixtures.

The tractor is driven so that the seat 11 engages the lower part of a bale, either at or above ground level. The actuator 21 is operated so that the arm 3 arches to a position surrounding the bale B, with the rollers 34 engaging the bale B opposed surface.

30 The combined frame 2 on one side and the distal end of the arm 3 on the opposed side surround greater than 180° of the bale B. The bale is in contact with the frame lower portion 10 at the bumper 14 only (Fig. 11) or the seat 11 (bale curved surface engaging, Fig. 12), and with the rollers 34 on the opposite side. This gripping function is very gentle, and advantageously the



controller applies only the required force to clamp the bale without damaging it or puncturing the wrapper. When the apparatus 1 is tilted back the bale B lifts. This may be done irrespective of the angle of approach and the bale's orientation.

5 As shown in Fig. 11 the bale is lifted with an orientation with its axis vertical, and in Fig. 12 is it horizontal. One of the benefits of the rollers 34 is best viewed in Fig. 13. In this case there are two side-by-side bales B, as is often the case in practice. The shape of the arm 3 and the action of the rollers 34 allow the arm to move down between the two bales B, forcing open a gap sufficient to grip the near bale without damaging either of them. The benefit of having a straight  
10 distal section 33 of the arm 3 is clear in this view also. The two rotating rollers 34 contribute to the apparatus 1 having the ability to handle plastics-wrapped bales without compromising the wrapper. The rollers 34 are positioned horizontally and are allowed to rotate freely. Such rollers allow an operator to quickly and effortlessly grab a bale with great ease and in a time efficient manner.

15 Advantageously, the frame 2 supports the pivot joint 4 and the hydraulic actuator 21, and it can be attached to any suitable operating vehicle. It supports the large pivoting arm 3 high up in the structure. The pivoting arm 3 is controlled at the short end by the hydraulic actuator 21, and supports the rotating horizontal rollers 34 at the outer or distal end the arm, and these rollers are  
20 allowed to rotate freely.

Due to the pivoting arm 3 being positioned high up on the frame 2 and being centred, allows the operator a very good view of from the operating vehicle. Having a centred location also ensures that the pivoting structure does not foul with bales B beside the bale being manipulated and  
25 compromising the plastic of neighbouring bales.

With the arm 3 being operated by the hydraulic actuator 21 on the short end, proximal of the pivot joint 4, ensures a large arcing radius of the main moving structure. Such an advantage ensures that the moving structure 3 can open wide enough and close in narrow enough to handle  
30 even the most distorted shaped bales, and this in turn allows the apparatus 1 to handle both round and square bales of any shape and size. Also, this allows the pivoting arm 3 to have a large arcing radius, eliminating risk of the pivoting arm 3 from fouling with other bales including the bale being handled when released, and from compromising the plastic wrapping. Similarly the

same geometry allows the pivot arm 3 to close into a relatively short distance to the manipulating bumper seat 11 as seen in Fig. 3

Advantageously, the fixed pivot joint 4 on the main upright or pillar 17 is positioned high up,  
5 higher than the bale that is to be gripped. The frame 2 and the pivoting arm 3 work together to gently squeeze a bale from over the top at opposite ends as shown in Figs. 11 and 12.

Due to the large arcing radius, the bale handling apparatus 1 has the ability to pick up and manoeuvre bales irrespective of their shape and size without compromising the plastics  
10 wrapping.

The manipulating bumper 14 has two main roles, it supports a large portion of the weight of a clamped bale, as shown in Figs. 11 and 12, and it allows the operator to gently push and manipulate bales when on the ground, into the desired position required by the operator.

15 The illustrated embodiment is capable of handling one large bale at any one time. However the apparatus is capable of being modified to allow the main upright frame to be extended laterally to support two or more main uprights and arms. Such a modification would allow two or more pivot arms to be fitted on the additional top pivot joints. Each pivot arm is designed to handle  
20 one large bale, therefore modifying the bale handling apparatus to support two or more pivot arms, and this will result in it being a multiple bale handling apparatus with significant increased output.

Referring to Fig. 14 an alternative apparatus 100 is shown, in which parts like those of the  
25 previous drawings are indicated by the same reference numerals. The apparatus 100 has two arms 3, and a wider frame 101 with an upper cross member 102, lateral end struts 103, a wide seat 104, and a correspondingly wide bumper 105. The apparatus 100 can be used to grip two bales and sequentially deliver them off at different locations. This is particularly suitable for large farms. As with the apparatus, the controller mounted in the tractor applies a constant  
30 gripping force to the arm and the frame while bales are being gripped. In this case hydraulic drive is provided to a valve box on the frame, and this routs hydraulic pressure from the vehicle to the arms 3 under operator control.

The invention is not limited to the embodiments described but may be varied in construction and detail. In another embodiment, the arm is not made up of straight sections, and instead has curved sections. In this case the overall length is suited to the maximum dimension of the bales to be lifted. Also, the arm may be mounted to the frame at a lower location. While this is not preferred, it is possible if the proximal end of the arm is directed upwardly and there is a larger angle between the distal end of the arm and the proximal end.

5

Claims

1. A bale handling apparatus comprising:  
a frame (2) having a means (16, 17) to mount to a vehicle,  
5 an arm (3) pivotally mounted (4) to the frame (2) and having a configuration, in a  
direction from the frame, extending distally and then downwardly, and  
an actuator (21) for rotating the arm (3) between an upper open position and a lower  
closed position for gripping a bale together with the frame,  
wherein the frame comprises a bumper (14) extending distally for engagement with a  
10 bale, said bumper having a front-facing curved surface.
2. A bale handling apparatus as claimed in claim 1, wherein the arm has a proximal section  
(31) mounted on the pivot joint (4) and a distal section (33) at its distal extremity  
extending downwardly with respect to a longitudinal axis of the proximal section,  
15 wherein the distal section is connected to the proximal section by an intermediate section  
(32), and wherein the distal section (33) longitudinal axis extends at an angle in the range  
of 80° to 100° to said proximal section longitudinal axis.
3. A bale handling apparatus as claimed in any preceding claim, wherein the arm has a box-  
20 section hollow configuration (36, 37).
4. A bale handling apparatus as claimed in claim 3, wherein the arm comprises a pair of  
channels (36, 37) facing into each other and fastened together to form said box section.
- 25 5. A bale handling apparatus as claimed in any preceding claim, wherein the bumper is  
formed at least in part by round tubes (14), and wherein the frame comprises an upper  
portion (17) and a lower portion (10), and said upper portion (17) is narrower than the  
lower portion and extends centrally upwardly with the configuration of a pillar, and  
wherein the upper portion has a box section configuration along at least part of its length.

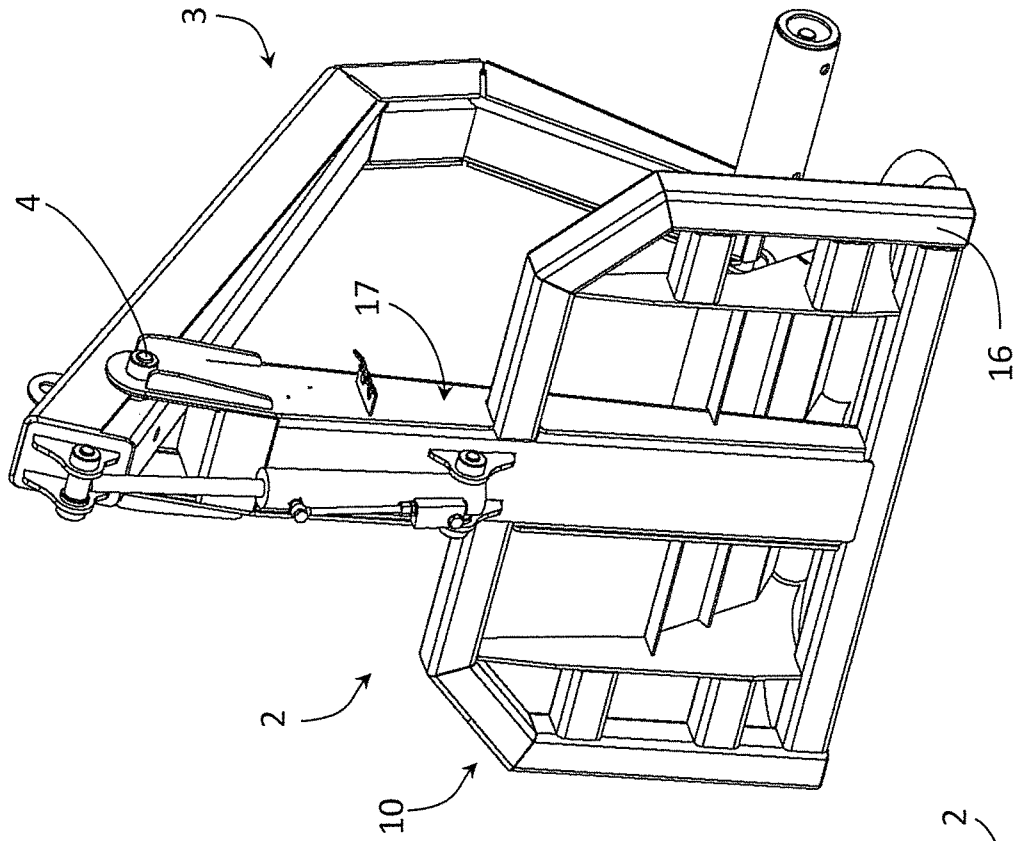


Fig. 2

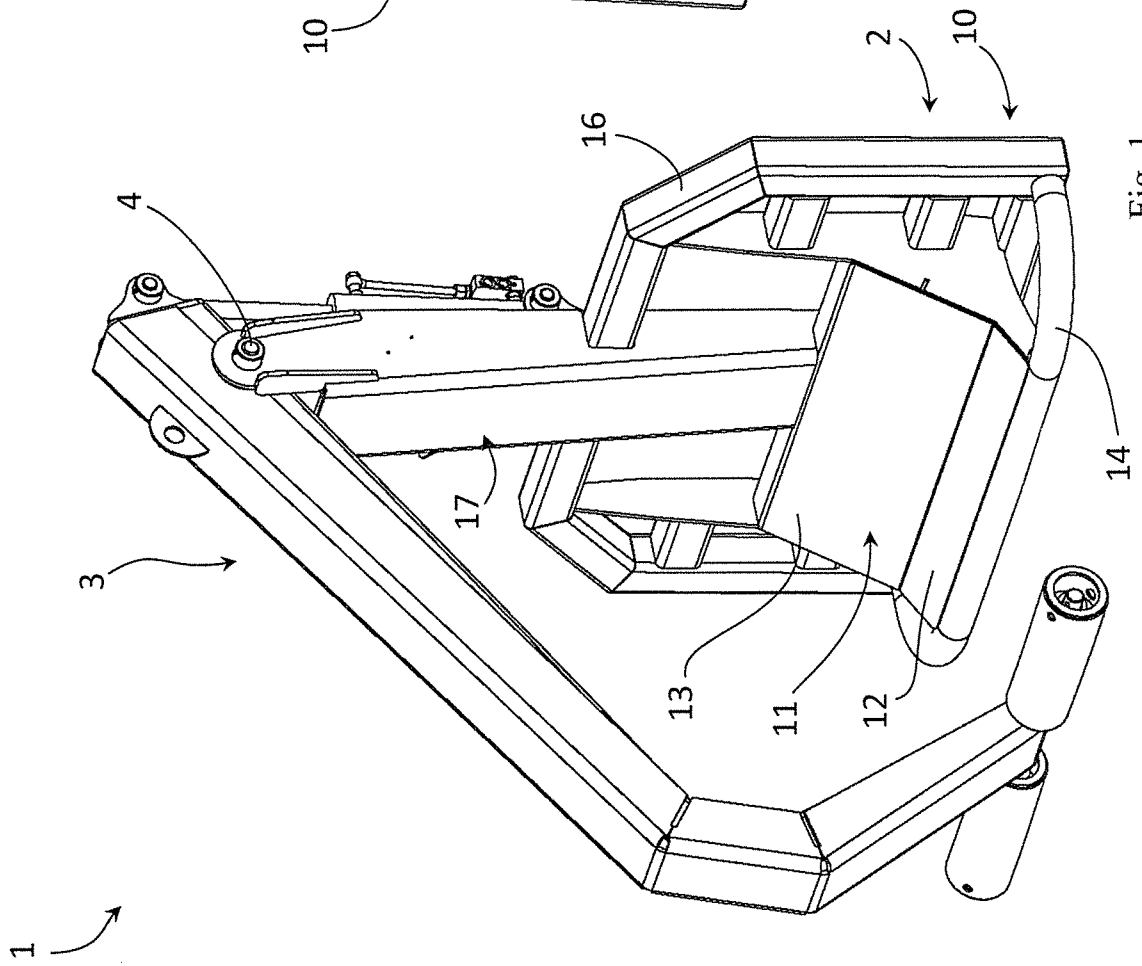


Fig. 1

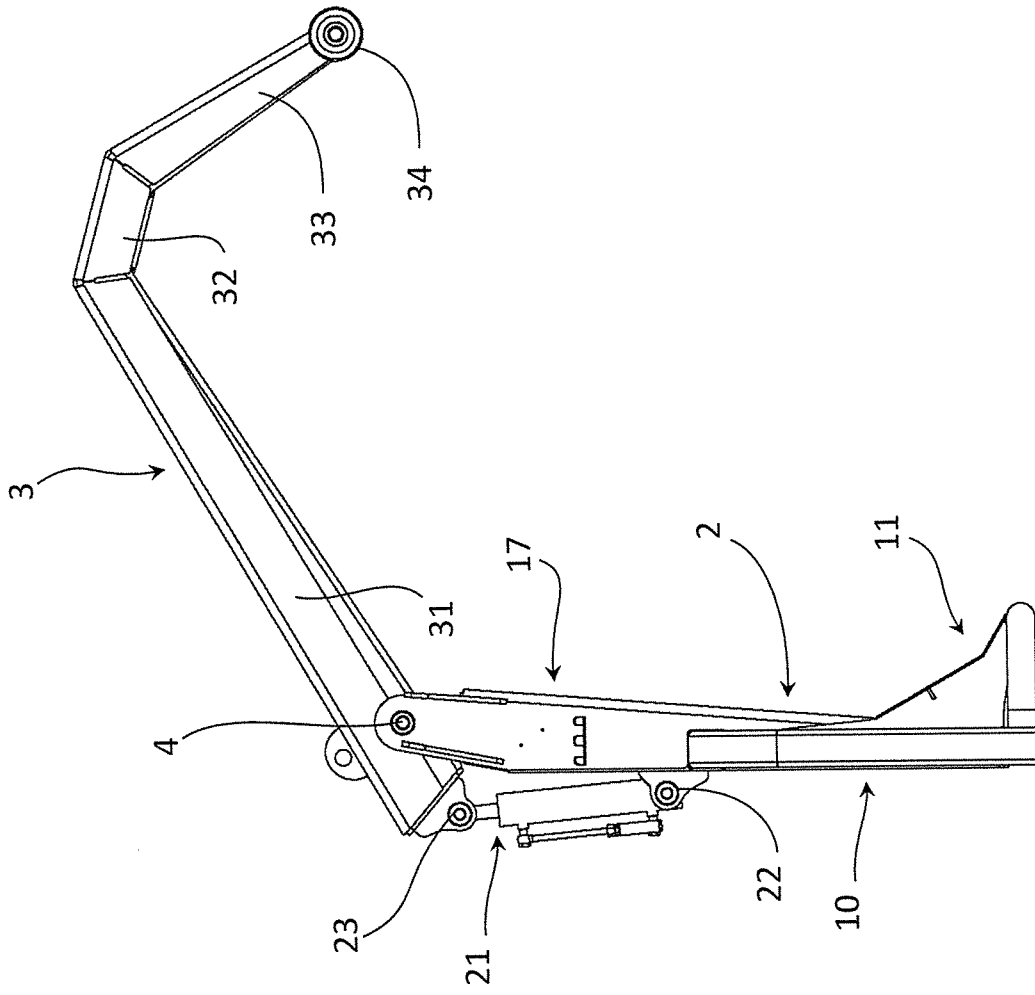


Fig. 3

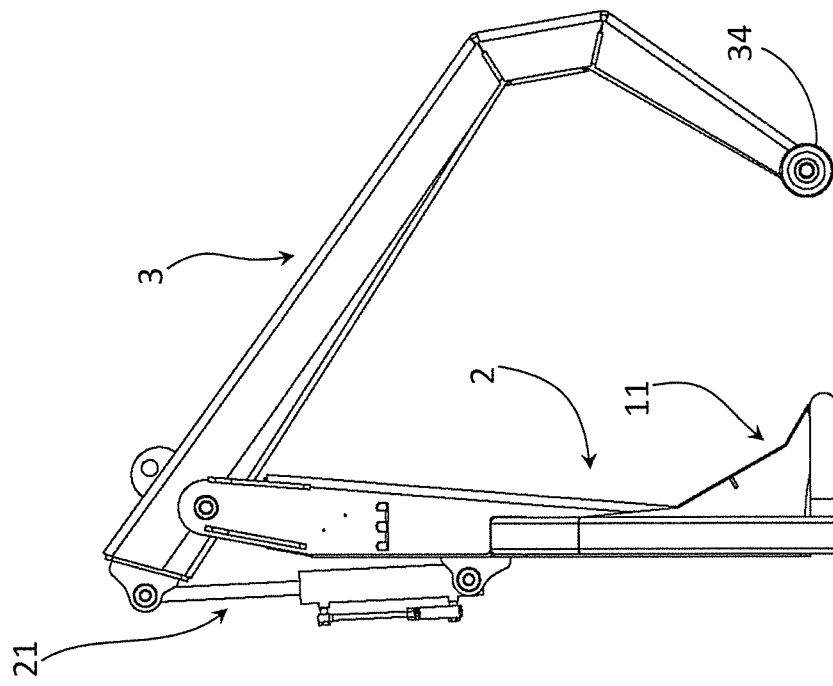
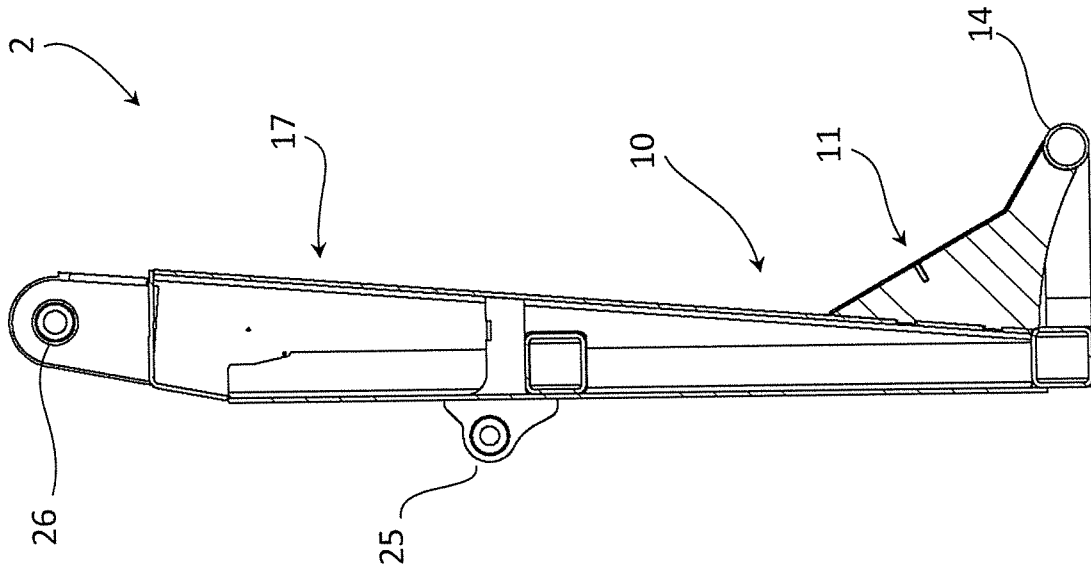


Fig. 4



SECTION H-H Fig. 6

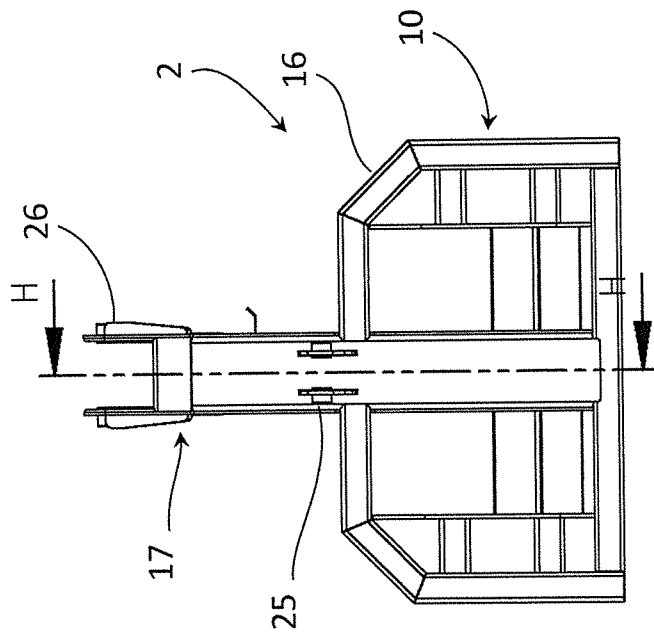


Fig. 5

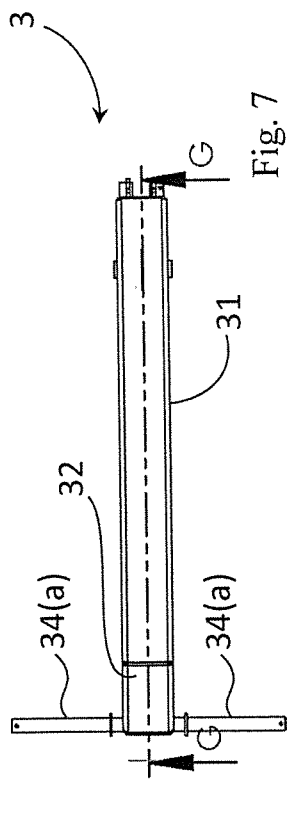
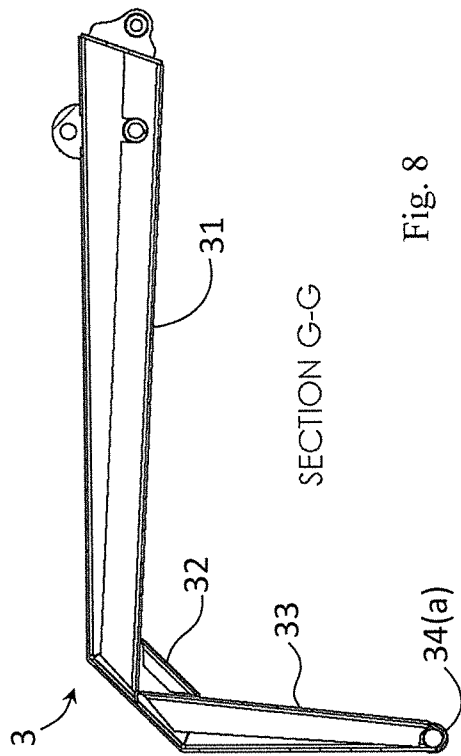
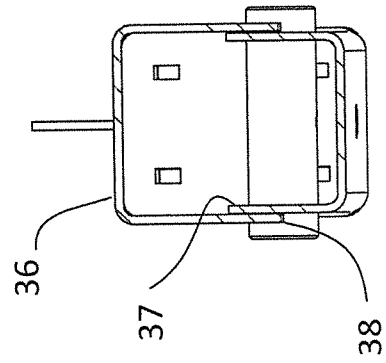


Fig. 7



SECTION G-G

Fig. 8



SECTION F-F  
Fig. 10

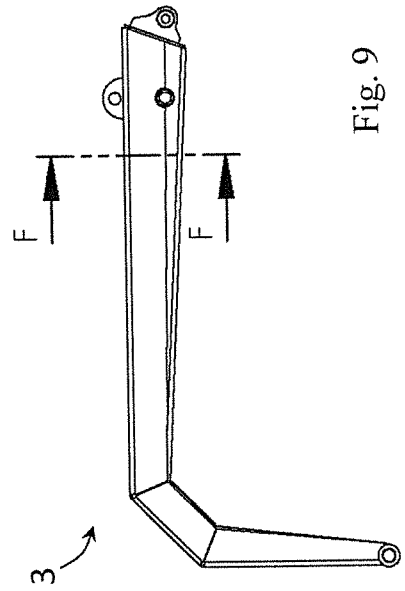


Fig. 9



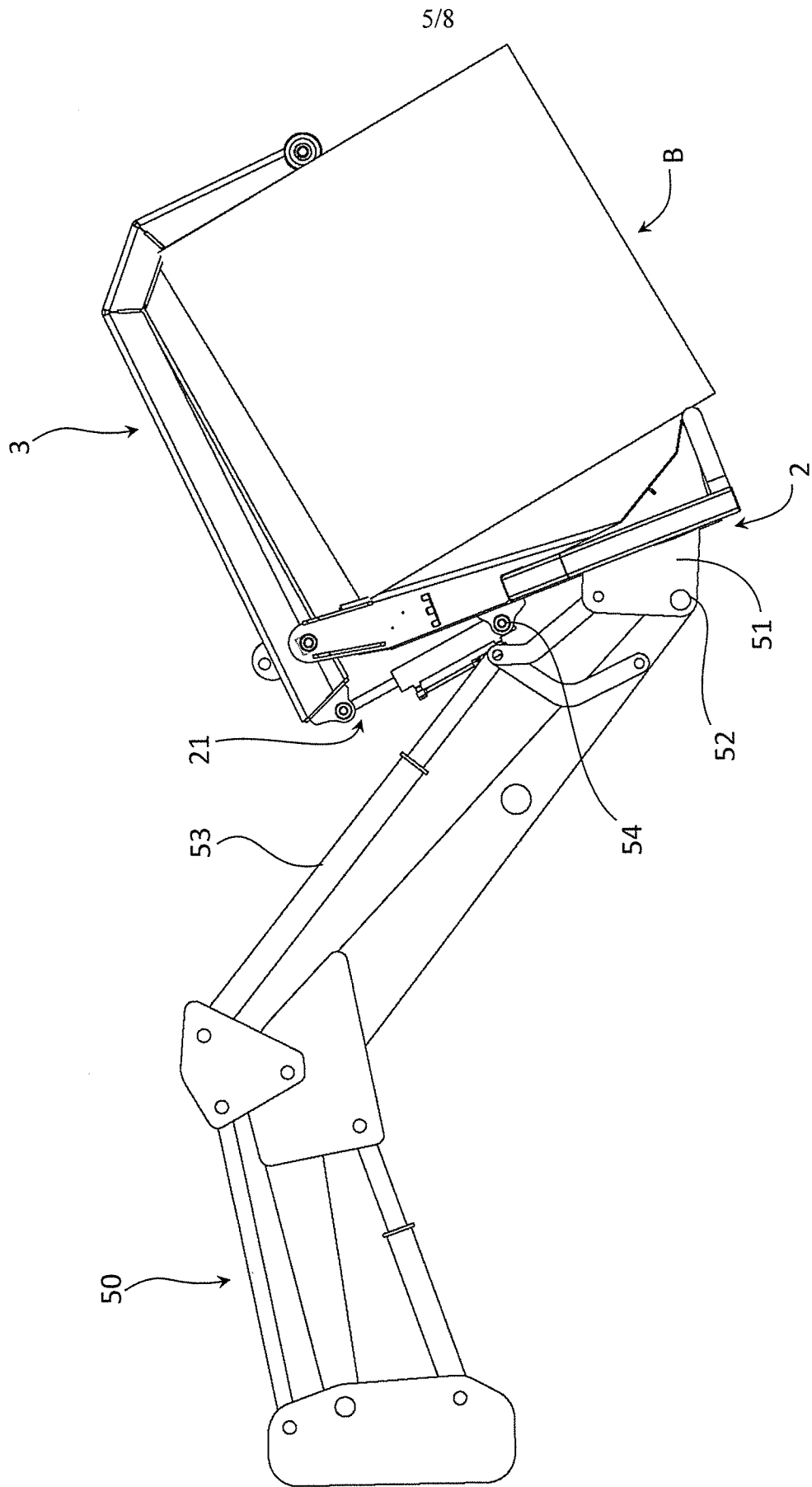


Fig. 11

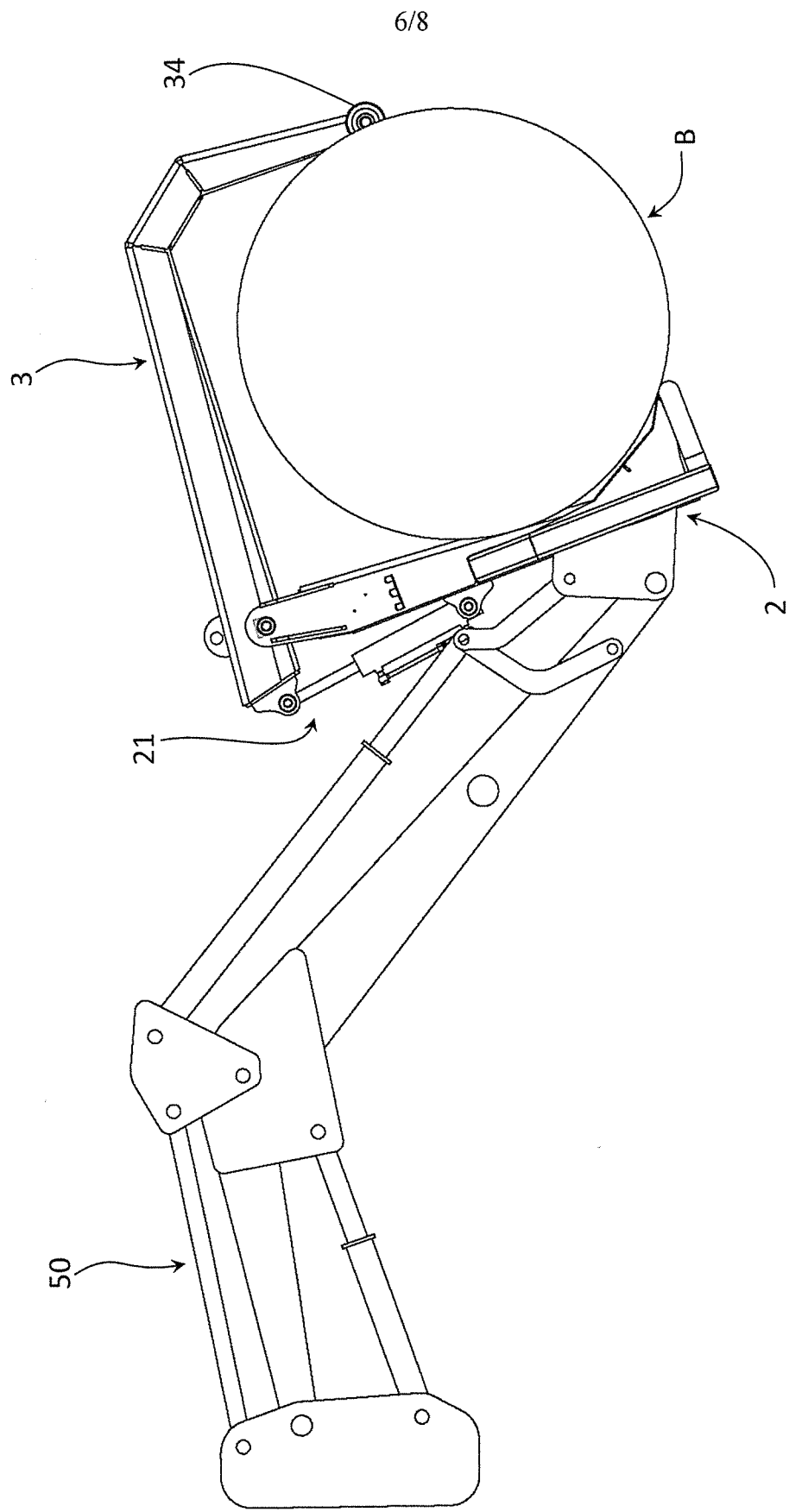


Fig. 12



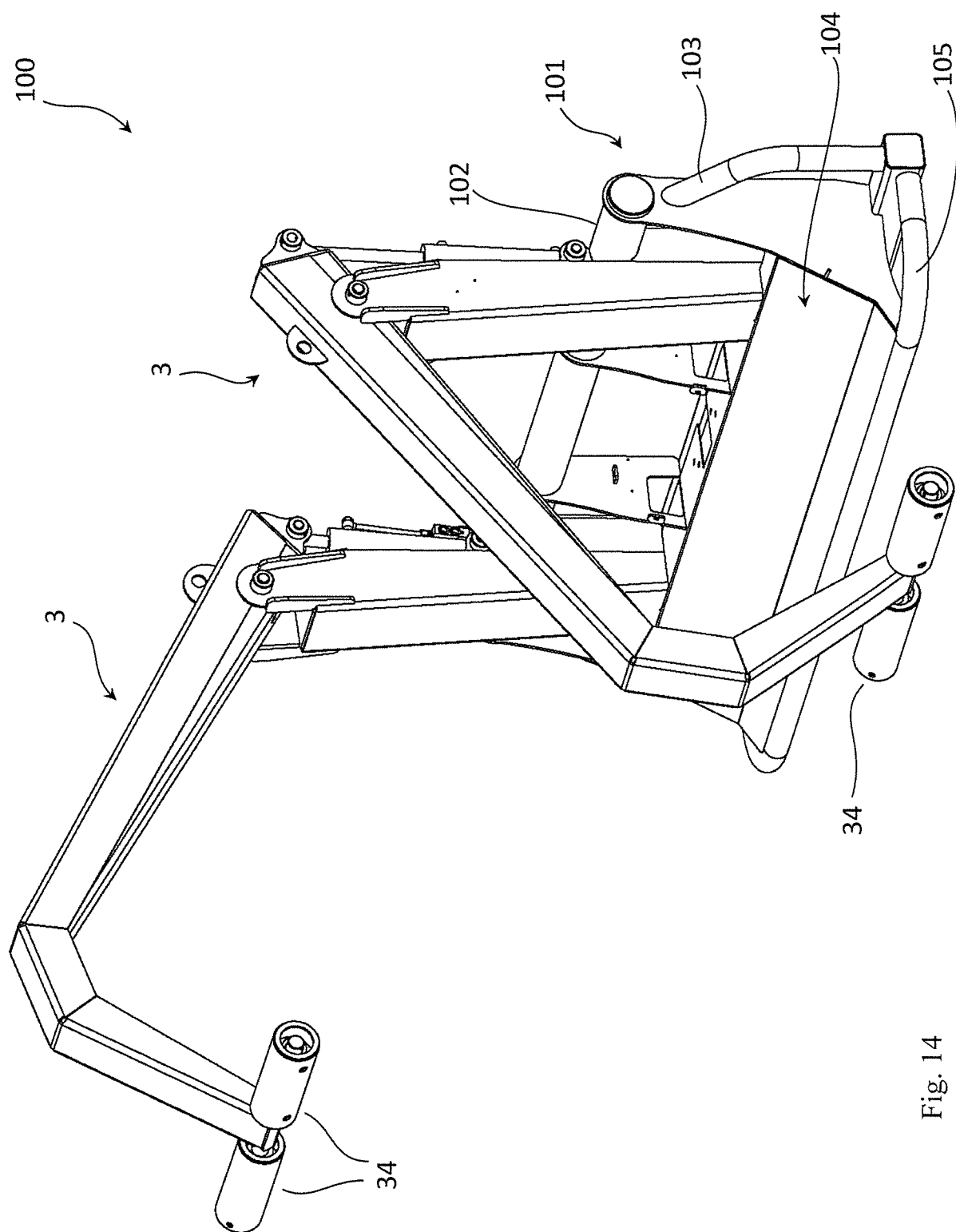


Fig. 14